

TFN040114-PCT

DIFFERENTIAL GEAR UNIT

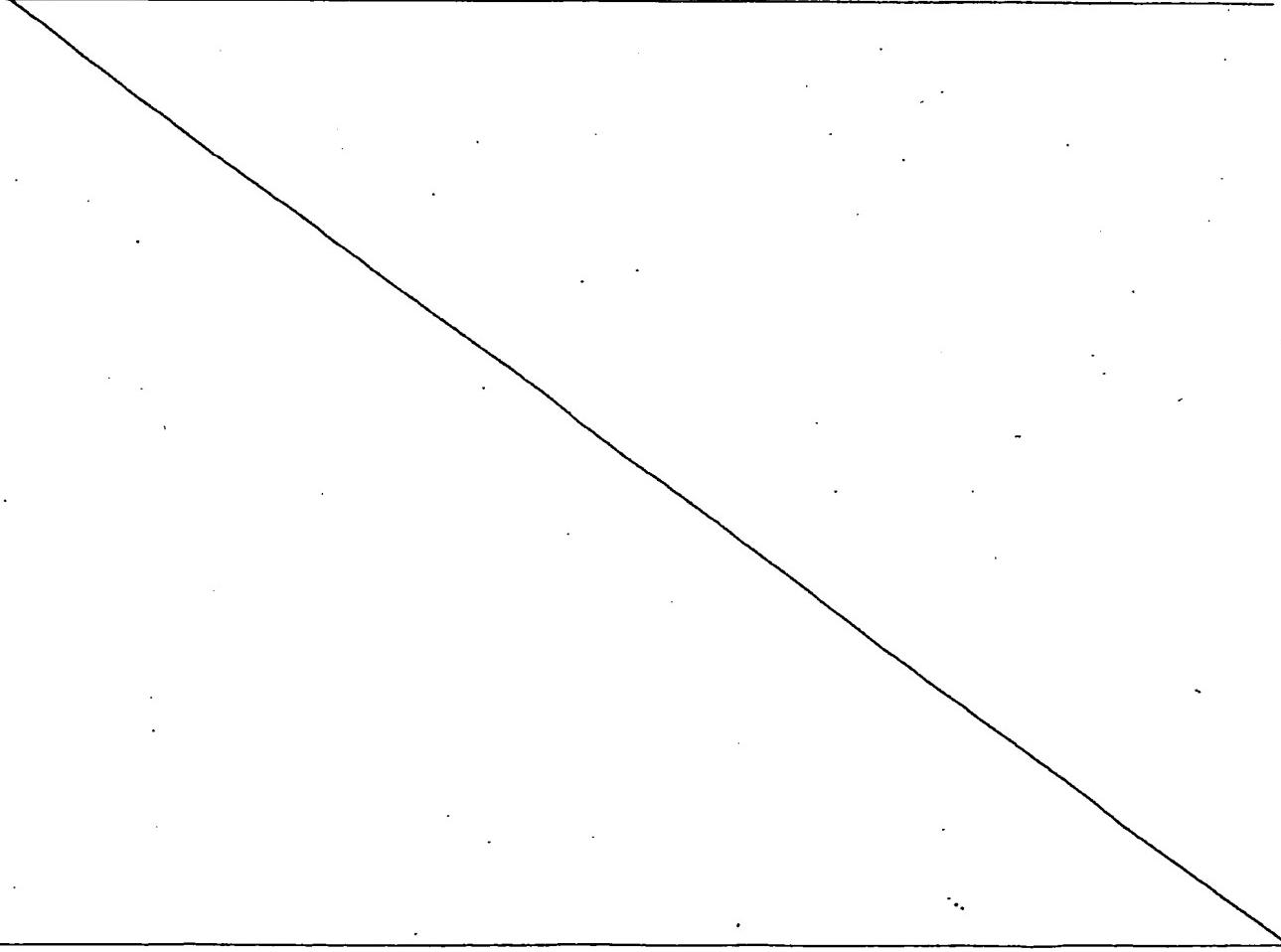
BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a differential gear unit. More particularly, the invention relates to a differential gear unit used in an automobile.

2. Description of the Related Art

[0002] A conventional type of differential gear unit for an automobile is disclosed in, for example, Japanese Patent Laid-Open Publication No. 58-144141. The Japanese Patent Laid-Open Publication No. 58-1⁴4141 discloses a technology in which simplified pinion shafts for four-pinions, instead of a pinion shaft for two pinions, is provided in the differential gear unit which conventionally includes an undivided differential case and the pinion shaft for two pinions, that is supported with each end portion inserted in the differential case.



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Further, types of differential gear units are known. Document DE 101 41 995 A1 for example discloses a differential case having two assembly openings, wherein these openings are symmetrically shaped with respect to the rotation axis and arranged in parallel with respect to a longitudinal centre axis of the differential gear casing.

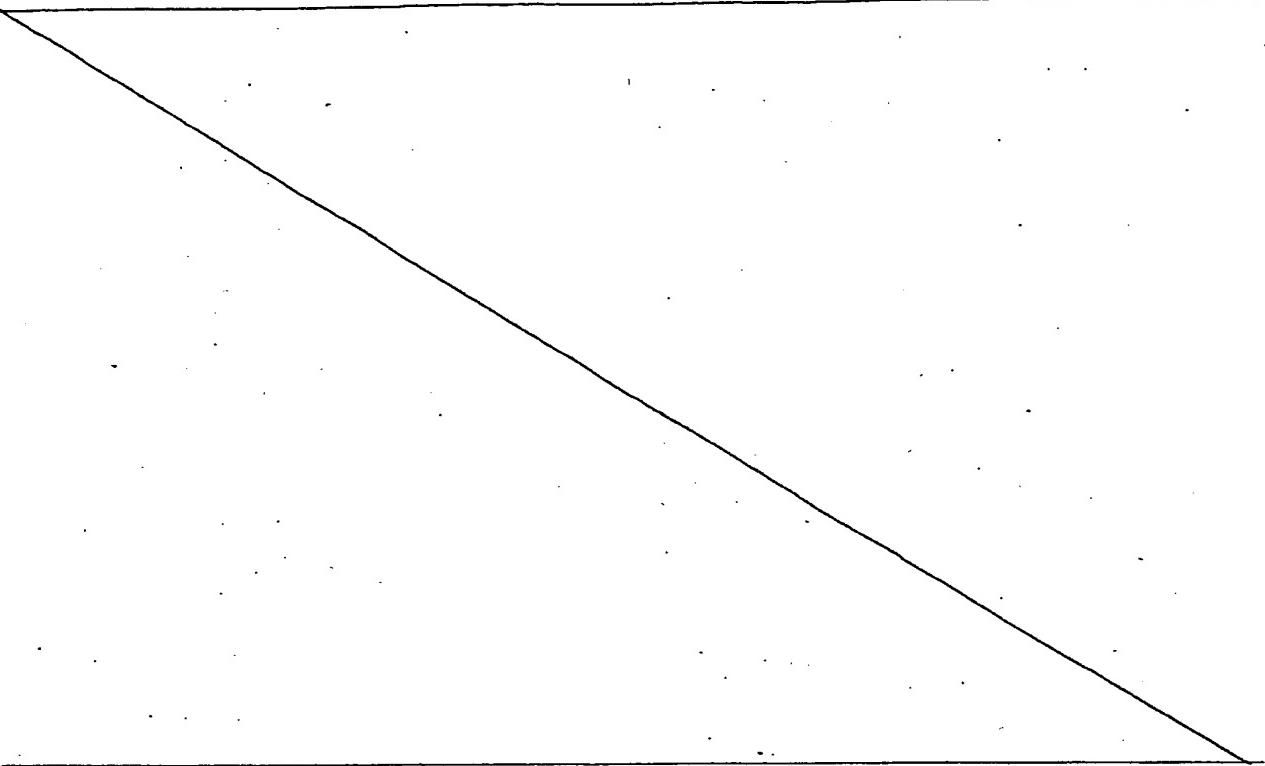
Further, document WO 89/10501 discloses a differential with a housing made in one piece, wherein the housing has two large side openings in its wall.

10 Each opening is provided with two guide members for guiding associated bearings.

Still further, document US 3,901,103 discloses a differential gear mechanism having long bolts spanning the large access hole in the differential case to increase the case strength in this region.

15 Document EP 1 433 978 A discloses a differential gear for a vehicle wherein three openings are formed in the differential housing. These three openings are formed at three equidistant positions along the perimeter wall section of the case for facilitating mounting side gears and pinions.

20 Finally, document US 5,954,431 A1 discloses a differential gear casing including at least one assembling window formed therein for providing access to a chamber interior of the differential case, wherein the at least one opening formed with two circular edge portions interconnected by a pair of elongated edge portions of the differential case, and is symmetrically shaped with respect to a rotation axis.



[0003] Generally, the frequency of driving a vehicle forward is higher than the frequency of driving the vehicle backward. Accordingly, the above-mentioned conventional type of differential gear unit has a problem that the fatigue life of a corner portion, in which a tensile stress is generated due to a driving force on the forward side, is insufficient. Particularly, when torque output from an internal combustion engine is increased, or when a driving force to be input is increased due to a design change of gear ratio of a transmission, the fatigue life of the corner portion, in which a tensile stress is generated by a driving force on the forward side, is particularly insufficient. However, in order to realize a differential gear unit which can withstand such a large driving force, a significant design change is required and the differential gear unit needs to be increased in size. As a result, there arise problems that the mountability of the differential gear unit deteriorates and the weight thereof is increased.

SUMMARY OF THE INVENTION

[0004] In light of the above-mentioned circumstances, the invention is made in order to solve these problems. It is therefore an object to provide a differential gear unit which can withstand a large driving force, and which makes it possible to minimize increases in weight and size thereof.

[0005] Therefore, according to an aspect of the invention, there is provided a